# A New *Proteriades* Reared From Trap Stems, Its Biology and Nest Associates
(Hymenoptera: Megachilidae)

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An intensive trap-nest study conducted earlier (Parker and Bohart 1966, 1968) yielded abundant information about the nesting habits and associates of many western twig-nesting bees and wasps, including 9 species of *Proteriades*. These trap-nest studies are continuing. As a result, nests of an unnamed *Proteriades* were collected during the 1973 and 1974 season. A description of the adults, the nesting biology, and the nest associates of the new species is reported here. Information concerning other species will be presented in a forthcoming paper on the biology of the genus.

In the following description of the adults, the term abdomen is the "apparent abdomen" called the Metasoma by some authors.

## *Proteriades shoshone*, new species
(Figs. 1–8)

*Holotype Male.*—Black, mandible apically, apical tarsomeres, tegula, base of abdominal sterna I–V reddish brown; abdominal terga I–IV mostly red except dark basal spot, spot progressively larger on succeeding terga; terga V, VI with narrow apical reddish brown band; tergum VII mostly red brown, darker medioapically; wings hyaline. Pubescence white, moderate, not longer than scape except for thinner, longer golden hairs on vertex, scutum; mandible with row of yellowish setae beneath; golden setae bordering apical margin of sterna; median basal thick pads of short, golden setae on sterna II–IV; terga with patch of hair at sides, extending apically, medially; apical hair band interrupted medially on terga I–III, entire on IV, V, absent on VI, VII. Punctation moderate, uniform, pits small, generally separated by a pit diameter, interpunctural integument shiny; punctures on clypeus, frons, interocellar area course, nearly contiguous; those on tibiae sparser, larger; dorsal area of propodeum shagreened basally, shiny, impunctate anteriorly; terga more densely punctate basally, apically; sterna finely, densely punctate in depressed area, less so apically. Scape twice as long as broad, flagellomeres shorter basally, apically longer; flagellomeres II–VI produced beneath overlapping base of succeeding article, more so on basal articles; clypeus slightly protuberant, shallowly convex, slightly overlapping base of labrum; clypeal margin convex, minutely sinuate, sublateral margin bent inward; head slightly broader than long, interantennal distance greater than antennocular distance; interocellar distance greater than antennocular distance; distance from base of antenna to median ocellus equal to distance from anterior ocellus to margin of vertex; distance between ocelli equal to distance from lateral ocellus to margin of vertex; genal width equal to ocellar width; inner eye margins nearly parallel; mandible bifid apically; width of mandible apically ¾ basal width; hypostomal carina raised entire length; labrum longer than broad, subtruncate apically; propodeum with large oval depression ending at propodeal orifice; mid coxa with small projecting basal flange; hind coxa with raised carina along inner ventral margin; femora bulbous, thickened submedially; tibiae bulbous subapically; terga I–V 3 times as broad as long; medioapical sulcus on tergum I deep, narrow, extending to midpoint; anterior margin of tergum VI produced, impunctate, curved to encompass tergum VII; tergum VII produced apically, its lateral margin with two short, blunt peg-like projections, margin between pegs sinuate, concave medially (Fig. 4), with shallow impunctate depression subapically; sternum I with apical margin produced into low concave keel; sternum II depressed over most of its length, basin-like; apical margin thickened, especially laterally, more sparsely punctured, broadly rounded; sterna III–V similar except apical margins concave, sternum IV more so; margin of sterna II–IV dense fringed with golden hairs; sternum VI with median protuberance arising mediobasally, covered with stout spine-like projections (Fig. 1); sterna V, VII, VIII as in figures 2, 3, 5; genitalia as in Fig. 6; body length 7mm; wings 4.4mm.

*Female.*—Like male except: mouthparts with longer setae, bent medially and apically, twisted; labrum with patch of long narrowed medioapical setae; hair bands on terga as follows: I, II interrupted medially, III–V entire, V and VI covered with white recumbent plumose setae; scopal hair not longer than hind hind basitarsus, rising from raised median horizontal area on each sternum; sternum VI densely bordered apically by short curved yellowish setae; interocellar area less punctate; clypeus with prominent swelling basally, with indistinct median longitudinal line (Figs. 7, 8), apical margin smooth, slightly indented medially; mandibles 3-toothed, apical teeth closer together than to inner one; mid coxa without flange; legs less bulbous, keel on sternum I less produced, conical; apical margins of sterna entire; sternum, tergum VI with broad, round apical margins; length 5–6mm.

*Variation.*—Two color forms occur in both sexes, one with the abdomen all black or with small areas of red on tergum I and the other with red markings on first 4 terga. The pattern of the red markings is diagnostic: terga I–III all red except for mediobasal black spot, black spot on tergum IV much larger. Most specimens (80% of males and 66% of females) are the black form. Both color forms were reared from the same cell series. I have reared similar color forms from nest series of another *Proteriades*, *P. bullifacies* Michener.

*Types.*—Holotype male and 79 paratypes (14 male, 65 female): 5 mi. E. Wells, Elko County, Nevada. All specimens reared from trap stems placed in a roadcut adjacent Interstate 80. Holotype male deposited in the collection at the U.S. National Museum, No. 73496. Paratypes are in the collections at the USNM, University of Kansas, and the Logan Bee Laboratory.

*Range.*—Eastern Nevada.

*Systematics.*—*P. shoshone* is related to *bidenticauda* Timberlake and Michener, but the former can be separated in the male by the indented apical margin of tergite VII and the absence of oblique swellings on abdominal sternite II. Females of *shoshone* can be separated from those of *bidenticauda* by the former having golden pubescence on the vertex and scutum, the distance between ocelli less than the ocellocular distance, and more distinct hair bands on the first 4 tergites.

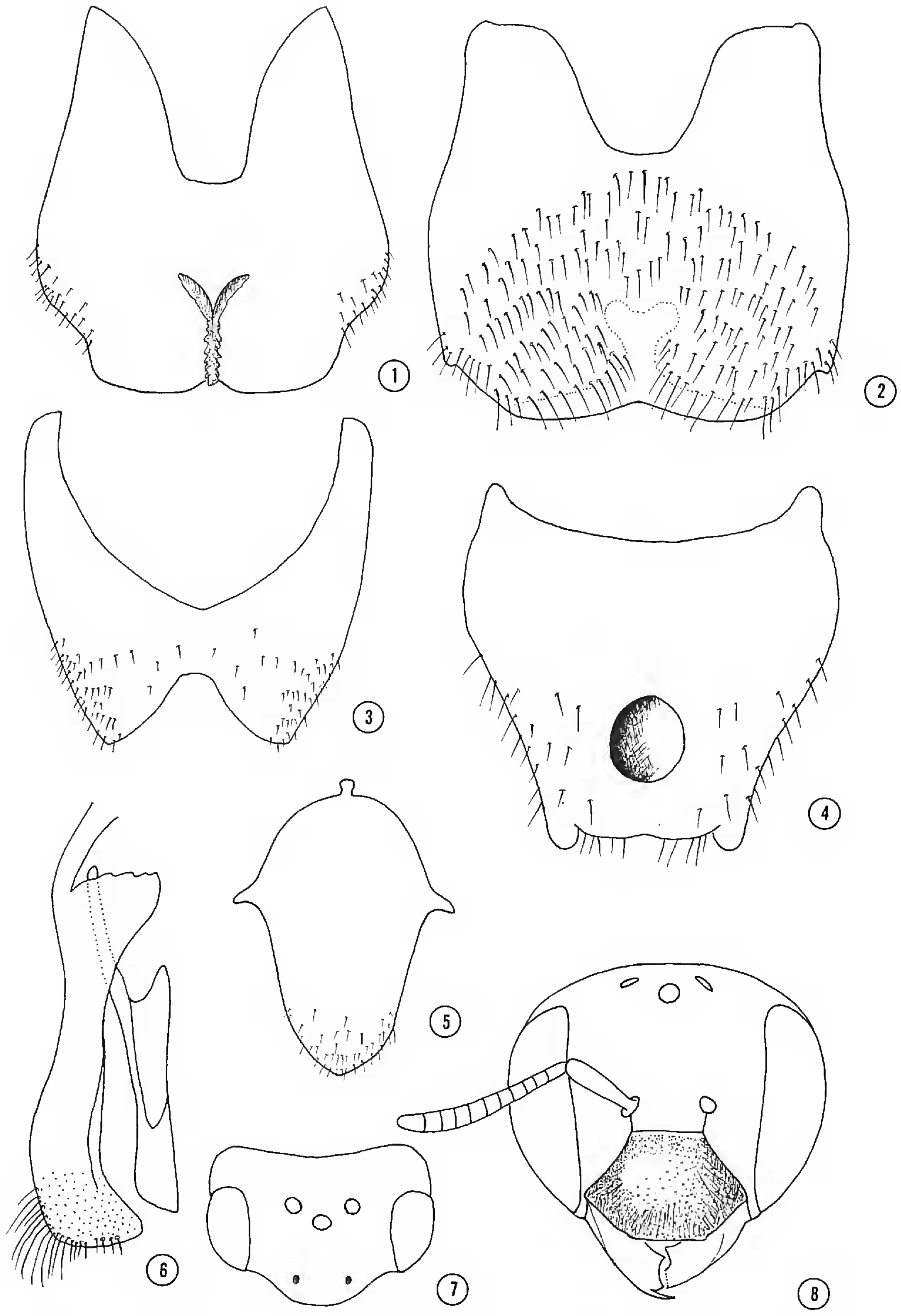
## BIOLOGY

*Nesting Site.*—All nests (65, containing 157 cells) were recovered from prebored elderberry trap stems each with a bore diameter of 3 or 6mm. The stems were placed at the type locality ca. 5 mi. E. Wells, Elko Co., Nevada, adjacent to Interstate Highway 80 on the east side. The site is a broad sloping roadcut dominated by sweet clover near the road and scattered *Cryptantha* plants above. The trap stems were placed in a long line at the juncture of the roadcut and the natural vegetation [dominated by rabbitbrush (*Chrysothamnus*), sagebrush (*Artemisia*), and juniper shrubs (*Juniperus*)]. More nests were recovered the first year (51) than the next (14).

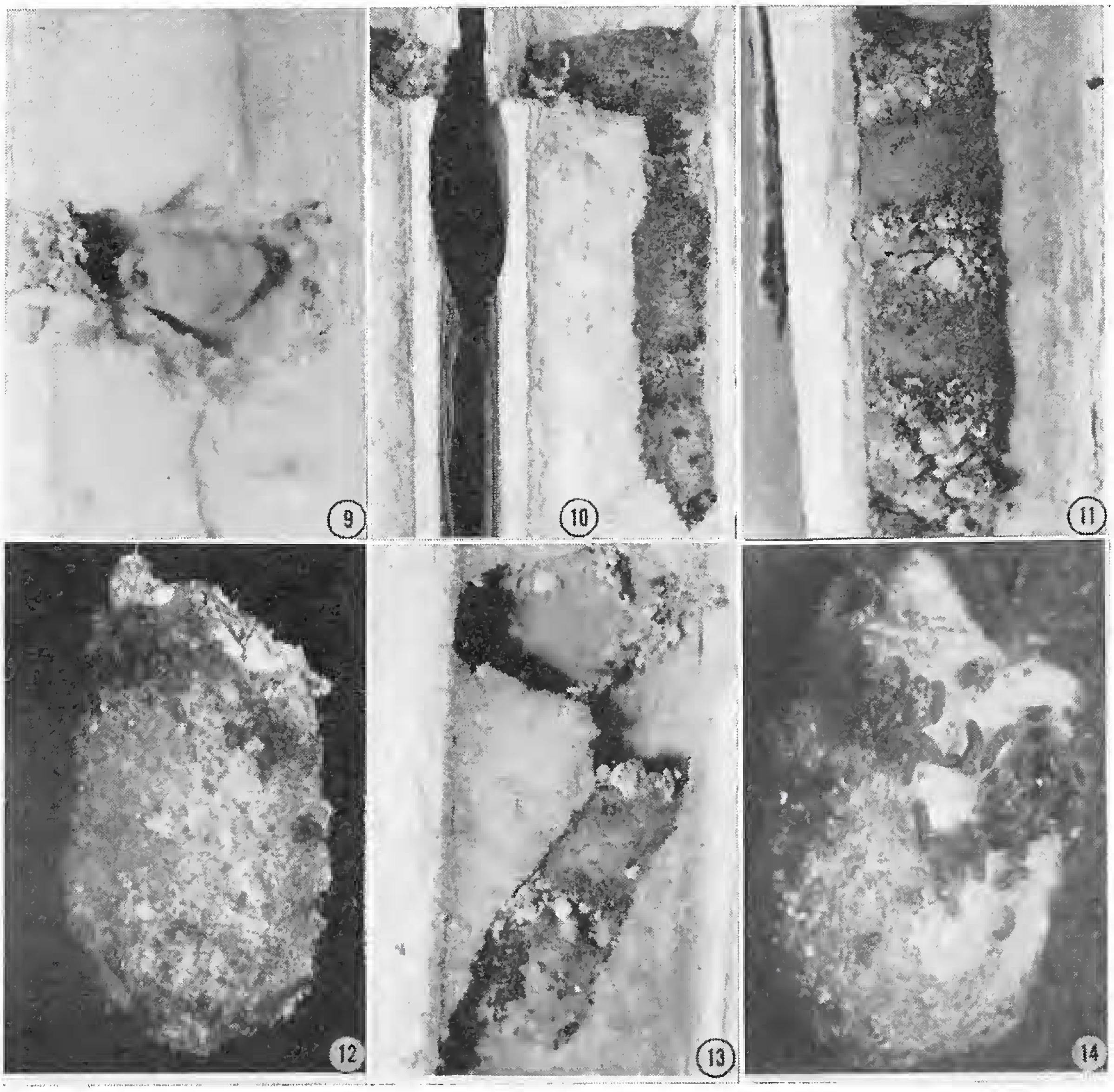
*Nest Construction.*—This bee preferred the small side holes (3mm) for nest building; in 1973, 69% and in 1974, 80% of the nests were located in these holes. Some nests, 14% in 1973 and 13% in 1974, were made in medium-sized holes (6mm). Nests made in end holes were near the top of the boring; an empty space 20–80mm long was under the first cell. Cells were initiated by partitioning end burrows with thin discs (1mm) of a mixture of gravel, soil, and coarse sand stuck together with macerated plant parts (Fig. 11). The partitions were 4–7mm apart depending on width of the boring. In wider borings, the cells were 6 × 4mm (Fig. 11), but in narrower holes the cells were 4 × 7mm (Fig. 9). Nests in side holes were initiated at the end of the burrow, and the end of the hole was not supplemented with nest-building material. Many of the side holes were enlarged and tunneled out (Fig. 10) to hold as many as 7 cells in a series. One burrow was wide enough to accommodate cells made side by side instead of the usual pattern of one cell above the other. It is uncertain whether *P. shoshone* actually enlarged the borings or if it merely utilized borings of other aculeates. Bees nesting in end holes never utilized all the available space in the holes and many loose pieces of pith were not removed, so it may be that these bees do not modify the nesting burrow. Some cell partitions were made diagonally across the burrows, especially in wide borings. Nest entrances were capped by the same mixture as used in the cell partitions, and some plugs were 5mm thick. The nest entrance was capped flush with the outer rim in side holes, but end holes generally were capped 6–11mm inside the borings.

*Provisions.*—The pollen ball was cylindrical, 3mm wide and 5mm high (Fig. 9) in nests with horizontal cell partitions or those at ends of borings. The egg was placed on top of the pollen loaf near the edge and extended inward.

In sloping cells the bottom of the pollen ball conformed to the slope




FIGS. 1–8. Fig. 1. Sternum VI of male. Fig. 2. Sternum V of male. Fig. 3. Sternum VII of male. Fig. 4. Tergum VII of male. Fig. 5. Sternum VIII of male. Fig. 6. Genitalia of male. Fig. 7. Dorsal view of female head. Fig. 8. Female face.




FIGS. 9–14. Fig. 9. Cell with 2nd instar larva dead on pollen ball. Fig. 10. 3-celled nest made in side of trap stem. Fig. 11. 2-celled nest made in end burrow. Fig. 12. Cocoon, note fussy appearance and fecal pellets near the top. Fig. 13. Nest in side hole, bottom cell with *Stelis* cocoon, note nipple at top of cocoon. Fig. 14. Cocoon of *Stelis* (*Stelidina*) sp.

of the cell, but the sides of the pollen loaf were cylindrical and the top was round. The pollen loaf was compact and composed entirely of *Cryptantha* pollen. Not all the provisions were consumed by some larvae, as small amounts clung to the bottom of the cocoon.

*Feces.*—Most fecal material was pellet-shaped, orange-brown, uniform, 0.5mm long (about twice as long as broad), with ends usually rounded, sometimes pointed, an impressed mediolongitudinal line on the surface. Some of the feces were flattened into long strands and incorporated into the cocoon (Fig. 12), giving it a striped appearance when held to the light.

*Cocoons.*—The oval cocoons appeared fuzzy on the outside due to the abundant short silk strands that attached it to the cell walls (Fig. 10–12). Cocoons filled most of the cell in short cells, but not in longer ones. The bottom of the cocoon was round, but the top flatter with longer twisted silk strands covering the surface. The cocoon on the inside was smooth and shiny and composed of 2 layers with fecal material deposited between the layers. Cocoons were usually amber but rarely white.

*Immature Forms.*—Prepupae were white and not very active when disturbed.

*Sex Ratio.*—An unusual ratio of females to males emerged, 4.3:1. Most nests had the typical pattern of females at the bottom and males above; but in some nests, the sexes were mixed and in others all were of one sex. Sex ratios of females to 1 male in the cell series, beginning with the first cell, were: 3.5, 6, 5.5, 2.3, 2.1, no males, no males. The range in time for emergence to the adult stage from overwintering larvae incubated at 72°F was: males 23–25 (24.2) days, females 25–29 (24.5) days.

*Nest Associates and Mortality.*—In 1973 only 3% of the cells were parasitized, all by the megachilid bee, *Stelis* (*Microstelis*) *coarctatus* Crawford. One cell was destroyed by an unknown predator. Cell mortality due to unknown causes totaled 11%, with 5% occurring in the egg stage and 6% in larval stages. Parasitism increased markedly in 1974, to 52%, but this year all the parasites were another species of *Stelis*, an unnamed species of the subgenus *Stelidina* (Figs. 13–14). Cell mortality due to unknown causes during the 1974 season was only 4%, and this occurred in the larval stage.

*Supercedure.*—Two nests in 1973 and 1 in 1974 were constructed above existing nests of another megachilid bee, *Hoplitis productus* (Cresson).

## DISCUSSION

I believe this to be the first description of an actual nest of a *Proteriades*. A brief note on the rearing of *P. xerophila* (Cockerell) from old cells of *Anthophora linsleyi* Timberlake (Linsley and MacSwain, 1942) prompted Timberlake and Michener (1950) to presume that all *Proteriades* species nest in the ground. A solely ground-nesting habitat for the genus was invalidated when Parker and Bohart (1966, 1968) established that *P. xerophila* and 8 other species of *Proteriades* nested in a variety of situations above ground including old galls on *Tetradymia*, burrows in stems of *Tetradymia* and *Oenothera*, and trap stems. Linsley and MacSwain (1942) described *P. xerophila* nesting habits as follows: "cells are constructed with macerated plant material—the young larvae spin a tough yellowish cocoon." I have reared *P. xerophila* from 33 nests, and none of the cells were made from macerated plant material alone nor were the cocoons yellowish white and tough. Cells of *P. xerophila* are constructed with coarse sand and macerated plant material, and the cocoons are delicate and very white. Linsley and MacSwain's description is accurate for cells of *Hoplitis biscutellae* (Cockerell), a common bee which these authors also reared. Thorp (1968) reported on a nest of *P. bunocephala* Michener, but I question the identity of the nest builder since: (1) no larvae in the nest were reared to the adult stage, thus making it difficult to positively establish what the inhabitants were because of our lack of information on characters that differentiate larvae among these bees; (2) the female observed entering the nest could have been searching for a nesting site or just beginning a nest above the one described as a *Proteriades*; (3) nest partitions were "masticated leaf and plant materials." All 15 species of *Proteriades* I have reared (800 nests, 3014 cells); as well as 4 species of *Hoplitina* including *bunocephala* used coarse sand in nest construction; and (4) the description of the nest and larvae apply more to *Ashmeadiella* than to *Proteriades*. Both previous reports on nesting of *Proteriades* were based on nests obtained from old nesting material, and it is extremely difficult to state precisely nesting characteristics of one species if the other species have occupied and altered the nesting burrow! Abundant information on the biology and nest associates of other reared *Proteriades* will be presented in a forthcoming paper on the biology of the genus.

## ACKNOWLEDGMENTS

I would like to thank Dr. C. D. Michener (Univ. Kansas) for examining the new species and reviewing the manuscript. Thanks are also due Dr. P. D. Hurd (Smithsonian Institution) and G. E. Bohart (Utah State Univ.), who also reviewed this paper. Mr. W. P. Nye and H. Potter took some of the photographs. Thanks are also due to H. Potter and D. Edgar for drilling holes in the trap stems.

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## SCIENTIFIC NOTE

***Aprostocetus diplosidis*, a Parasite of the Sorghum Midge Found in California (Hymenoptera: Eulophidae).**—*Aprostocetus diplosidis* Crawford, a parasite of the sorghum midge *Contarinia sorghicola* (Coquillett), was first described from material collected near Baton Rouge, Louisiana (Dean, 1911: USDA Bull. 85 (IV): 39–58). Its distribution generally follows that of its host although several years may elapse between the discovery of the midge and the appearance of *A. diplosidis* (Dean, 1911: *Ibid*). *A. diplosidis* was introduced into Texas (San Antonio) in 1908 (Dean, 1910: J. Econ. Ent. 3: 205–7) and although it is very aggressive, it appears to have been displaced by another parasite, *Eupelmus popa* Girault (Walter, 1941: USDA Tech. Bull. 778). The latter species has been reported by Woodruff (1929: J. Econ. Ent. 22: 160–7) to feed on *A. diplosidis* larvae.

*C. sorghicola* was first recorded in California (Tulare Co.) in 1960 by Lange, Marble, Pendery, Burton (1961: Calif. Agri. 15(1): 7–9) but no parasites were found at that time. During field investigations in 1972 I found several small wasps in emergence cages used to determine the midge infestation level in sorghum heads. These were tentatively identified by Dr. R. L. Doutt (Dept. of Entomological Sciences, University of California, Berkeley) as belonging to the genus *Aprostocetus*, "species probably *diplosidis*." Subsequent examination of additional material and reference to Burks' key (1967: Ann. Ent. Soc. Amer. 60: 756–60) confirmed that the specimens were *A. diplosidis*. The first individuals emerged 28 Sept., 1972 from sorghum heads collected near Ivanhoe (Tulare Co.) on 11 September. *A. diplosidis* also emerged from sorghum heads collected from two other fields, one in the Ivanhoe area, sampled on 11 Sept., the other 5 miles south-east of Dinuba (Tulare Co.) sampled on 18 September. No *A. diplosidis* emerged from 480 sorghum heads collected from sorghum at the Kearney Horticultural Field Station, Parlier (Fresno Co.), California. Based on emergence data of *C. sorghicola* and *A. diplosidis* in the three fields from which it was collected, the rate of parasitism was $< 1\%$.

During 1973 I surveyed sorghum fields throughout Madera, Fresno, Tulare, Kings, and Kern counties. *A. diplosidis* was found in only two locations, one near Ivanhoe on 25 Sept., adjacent to a field where it was collected in 1972 and a second on 28 Sept. from a sorghum trial at the Kearney Horticultural Field Station. As in 1972, parasitism was $< 1\%$. No specimens of *A. diplosidis* were found during a similar survey in 1974. The present known distribution of *A. diplosidis* in California is shown in Fig. 1.